Novelties in *Croton* (Euphorbiaceae) from Southeast Asia

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ABSTRACT. A new species, *Croton kongkandanus* Esser, is described from Thailand, based mainly on its large fruits. The name of *Croton lissophyllus* from India and Bangladesh is validated, and *C. laniflorus* Geiseler is recognized as the valid name for the poorly known and illegitimate *Croton lanatus* Loureiro from Vietnam and described here. Seven taxa of Southeast Asian *Croton* are lectotypified, two new synonyms are proposed, and two potential ones are discussed, some of them in preparation for inclusion in the *Flora of Thailand*.

Key words: Asia, Bangladesh, *Croton*, Euphorbiaceae, India, Thailand, Vietnam.

The revision of Euphorbiaceae for the *Flora of Thailand*, recently conducted by staff of the Forest Herbarium, Bangkok, and collaborators, had a reliable basis in the study of Thai Euphorbiaceae by Airy Shaw (1972). Nevertheless, several novelties and problems came to light, among them some in the genus *Croton* L. In connection with this project, taxonomic problems in *Croton* from Indochina and India were studied. The complete revision of *Croton* for the *Flora of Thailand* will be published separately, but some notes on *Croton* in Thailand and adjacent regions are recorded here. Thai localities are cited in accordance with the guidelines for the *Flora of Thailand*.

Croton chevalieri Gagnepain, Bull. Soc. Bot. France 68: 550. 1921 [1922]. TYPE: Vietnam. Bienhoa, reserve of Trang Tôm, 30 Mar. 1914 (fl), *A. J. B. Chevalier 32048* (holotype, P; isotype, A).

In contrast to the other species of *Croton* he had described in 1922, Gagnepain did not accept *C. chevalieri* later in 1925 (Gagnepain, 1925), but listed it under his dubious species at the end, not including it in his key. *Croton chevalieri* is based on a single, rather poor collection. It is most probably not a separate species. It resembles *C. poilanei*, except that the hairs are stellate to stellate-lepidote, whereas lepidote hairs are diagnostically important for *C. poilanei*. It might prove to be an aberrant collection of the latter on further study.

Croton delpyi Gagnepain, Bull. Soc. Bot. France 68: 552. 1921 [1922]. TYPE: Vietnam. "Ad Deon-ba montem prope Cay minh," Apr. 1866 (fl, fr), *L. Pierre 6231* (lectotype, designated here, P; isolectotypes, BM, K, P).

Among the four syntype collections, *Pierre 6231* is the one with the largest number of duplicates found and the only one with both flowers and fruits. The sheet with analytical drawings attached to it, made by E. Delpy, is chosen as the lectotype.

Croton griffithii Hooker f., Fl. Brit. Ind. 5: 392. 1887. TYPE: Malaysia. "Malacca," s.d. (fl, fr), *W. Griffith 4781* (lectotype, designated here, K; isolectotype, K).

Hooker noted in his protologue that his new species might be heterogeneous. Among the nine syntype collections at Kew, six (*Griffith 4778, 4781, King's Collector 1115, 4484, 6157, Scortechini s.n.*) agree with the current concept of *C. griffithii* (leaves drying yellowish brown, cordate-rounded at base, with abaxial glands), whereas two (*Wallich 7754, 7967*) belong to *C. laevifolius* Blume (leaves drying darker, acute-obtuse at base, with lateral-adaxial basal glands). *Maingay 1406* was not studied. Airy Shaw (1972) was certainly correct to distinguish these two species that had been united by several authors in the past, such as Corner (1939). The above lectotypification fixes the current use of the name, with *Griffith 4781* being the only syntype bearing both flowers and fruits.

Among the two sheets of *Griffith 4781* at Kew, the one with analytical sketches of flowers and attached dissected flowers is chosen here as the lectotype.

Croton kongensis Gagnepain, Bull. Soc. Bot. France 68: 555. 1921 [1922]. TYPE: Laos. Pak-lay, leg. 1866–1868 (fl, fr), *C. Thorel s.n.* (lectotype, designated here, P; isolectotype, P).

The sheet with fruits and analytical drawings, which had already been separated in a type folder, is selected here.

Croton kongkandanus Esser, sp. nov. TYPE: Thailand. South-Eastern: Chon Buri, Khao Kieo Wildlife Sanctuary, 300 m, 25 July 1976 (fr), *J. F. Maxwell 76–443* (holotype, BK 56565; isotype, AAU).

Species *Crotonis* foliis ovato-ellipticis non triplinerviis pilis stellato-lepidotis argenteo-brunneis dense obtectis ad *C. argyratum* maxime accedit, sed ab eo fructibus multo majoribus 22–27 mm (non 12–16 mm) longis brevipedicellatis (3–4 mm, non 10–13 mm) differt.

Tree to 15 m tall, DBH to 25 cm; bark gray, smooth to very finely roughened and with prominent, scattered lenticels; young branchlets densely pubescent, glabrescent. Indumentum consisting of stellate to stellate-lepidote hairs (radii more fused on leaves) with a small brownish center and hyaline radii (appearing silvery) on the leaves, brownish on leaf veins and floral parts, flat, sometimes with a porrect central radius, ca. 0.2–0.3 mm diam., with ca. 20–30 radii. Stipules linear-elliptic, 7–20 mm long, densely pubescent. Leaves often apically crowded but basically alternate; petioles 25–55 mm long, densely pubescent; blades chartaceous, elliptic to slightly ovate, 11–19 × 5–8.5 cm, index 1.8–2.3, base obtuse with the very base cordate, margin entire, apex shortly acuminate, soon glabrous above, beneath densely silvery-pubescent and not glabrescent, hairs quite uniform, brown-tinged on venation; basal glands lateral on the abaxial midrib base, flat, sessile, 0.5–1 mm diam., marginal glands absent; side veins distinct on both surfaces, in 8 to 10 pairs, not triplinerved, tertiary veins visible on both surfaces. Inflorescences terminal, solitary, densely and persistently silvery-brown pubescent throughout, 8–10 cm long, consisting of a basal part of 1–2 cm with 2 to 6 pistillate flowers, without lateral staminate flowers in the same bract, and a larger upper staminate part, with 1 to 3 flowers per bract; floral bracts ca. 1 mm long, eglandular, quite persistent. Staminate flowers densely pubescent; pedicel 1–1.5 mm long; sepals ca. 2 × 1.5 mm; petals ca. 2–2.5 × 1 mm; stamens ca. 11, pubescent at base. Pistillate flowers densely pubescent; pedicel ca. 1 mm long; sepals ca. 4–5 × 2–2.5 mm, longer than the ovary; petals 2 × 0.5 mm; ovary 2.5 mm long; stylar column short (ca. 0.5 mm), stigmas 4–5 mm long, bifid on the apical ca. 3 mm. Fruits: pedicel 3–4 mm long; schizocarp 22–27 × 20–21 mm, elliptic to slightly obovate, not sulcate, densely pubescent outside. Seeds flattened-elliptic, 15–16 × 8–11 × 6 mm, smooth, brown, sometimes slightly variegated, caruncle not seen.

The species in named after Kongkanda Chayamarit of the Forest Herbarium, Royal Forest Department, Bangkok, who spent so much of her time and energy in arranging and organizing the Euphorbiaceae project for the *Flora of Thailand*.

This species probably belongs in *Croton* sect. *Argyrocroton* (Müller Argoviensis) G. L. Webster according to Webster (1993). *Croton kongkandanus* differs from all silvery-leaved species of *Croton* in Southeast Asia and Malesia by the much larger fruits, a diagnostically important difference. The other Malesian species with silvery leaves have fruits 4–16 mm long. In other characters, the new species is very similar to *C. argyratus* Blume. The latter has mature fruits 12–16 mm long on distinctly longer pedicels exceeding 10 mm, and is restricted to West Malesia, while in Thailand it is only known from the southernmost Peninsular provinces. The Indo-Chinese species *C. budopensis* Gagnepain and *C. maieuticus* Gagnepain, considered as synonyms of *C. argyratus* by Airy Shaw (1972), are all separate endemic species: *C. budopensis* has much smaller, subsessile fruits only 4–5 mm long, and *C. maieuticus* has a fruit size similar to *C. argyratus* but stipitate glands on the leaf bases.

Type and paratype collections of *C. kongkandanus* were distributed under the name of *Croton argyratus*.

The only Asian species comparable with *C. kongkandanus* in fruit size is *C. malabaricus* Beddome. This species is only known from southwestern India (Western Ghats) and was thoroughly described and illustrated by Chakrabarty and Balakrishnan in 1997. *Croton malabaricus* seems to differ in having shortly stipitate fruits and longer pedicels in staminate and pistillate flowers and fruits.

Croton kongkandanus is so far only known from Thailand. It grows in mixed deciduous and evergreen, seasonal hardwood forest, disturbed evergreen forest, found over shale bedrock.

Paratypes. THAILAND. **Northern:** Chiang Mai, Chiang Dao Distr., Doi Chiang Dao Animal Sanctuary, Huay Nah Lao Station, 600 m, 14 Aug. 1995 (fr), *Maxwell 95–496* (BKF, CMU); Tak, Pha Wo, 650 m, 13 July 1972 (fr), *Smitinand & Seidenfaden 11630* (BKF); Sukhotai, Sri Satchanalai National Park, 200 m, 7 Feb. 1988 (ster), *Smitinand s.n.* (BKF 87372). **South-Eastern:** Chon Buri, Khao Khieo Wildlife Sanctuary, 400 m, 27 Mar. 1976 (fl), *Maxwell 76–162* (AAU, BK, L); Chanthaburi, Khao Sabap National Park, 6 July 1927 (fr), *Put 912* (BK, BM, K, L, P).

Croton krabas Gagnepain, Bull. Soc. Bot. France 68: 555. 1921 [1922]. TYPE: Cambodia. Mekong river, Kratee, 9 Mar. 1914 (fl), *A. J. B.*

Chevalier 31882 (lectotype, designated here, P).

Although several of the remaining seven syntype collections (now paralectotypes) are distributed with duplicates, the chosen lectotype is the only sheet with attached analytical drawings, and with the vernacular name 'krabas prey' on the label, the source of the epithet. It is also one of the richest collections among the syntypes.

Croton lachnocarpus Bentham, Hooker's J. Bot. Kew Gard. Misc. 6: 5. 1854. TYPE: Hong Kong, *J. G. Champion* (holotype, K not seen).

Croton calococcus Kurz, J. Asiat. Soc. Bengal 42: 242. 1873. Syn. nov. TYPE: Burma. Rangoon, s.d., *S. Kurz 1607A* (lectotype, designated by Chakrabarty & Balakrishnan ("1992," published in 1997), CAL not seen; isolectotype, K not seen).

Croton bonianus Gagnepain, Bull. Soc. Bot. France 68: 549. 1921 [1922]. SYNTYPES: Vietnam. Lan Mak, 10 Nov. 1883, *R. P. Bon 2260* (A, P), *R. P. Bon 215* (P not seen), near Hanoi, But-son, 7 Dec. 1883, *R. P. Bon 2343* (A, P); Thinh-chau, *R. P. Bon 2568 bis* (P not seen).

Croton murex Croizat, J. Arnold Arbor. 23: 41. 1942. TYPE: Vietnam. 12 km N of Dankia-Langbiang, 27 Oct. 1930 (fl), *E. Poilane 18657* (holotype, A; isotypes, K, P).

Croton trachycaulis Airy Shaw, Kew Bull. 23: 74. 1969. TYPE: Thailand. South-Western: Prachuap Khiri Khan, Hui Yang, 3 Oct. 1930 (fl, fr), *Put [= Put Phraisurind] 3186* (holotype, K; isotypes, A, BK, BM, L).

This synonymy was largely (except for *C. calococcus*) included by Govaerts et al. (2000) after discussion with the author. The whole complex is best treated as a single polymorphic species, and was formerly divided into species mostly on the basis of two characters, indumentum and fruit surface. Fruit surfaces vary from smooth to muriculate seemingly as natural variation, not correlated with other characters or geography. The indumentum does show a geographical pattern: Plants from China are usually glabrescent on the upper leaf surface, with leaf hairs that are slightly smaller (ca. 0.8 mm diam.) with a central porrect radius not longer than the lateral radii. Plants from Thailand always have leaves pubescent above, and the hairs are often larger [(0.2–)0.8–1.5 mm diam.] and with an exceptionally long porrect radius, with the lateral radii short to nearly rudimentary on the upper leaf surface (not on other parts). This alone is probably not sufficient for separation at the species level. Further studies with a better representation from Indochina are necessary to evaluate if clear-cut differences exist somewhere along the cline. If the indumentum turns out to be significant, the correct name for the Thai plants is probably *C. calococcus*, and among the Vietnamese names at least *C. bonianus* certainly remains a synonym of *C. lachnocarpus*.

The two syntypes of *C. bonianus*, *Bon 2260* and *Bon 2343*, are mounted together on one sheet in both A and P, with one fruiting twig and one flowering but one joint label; they cannot be separated.

Croton laniflorus Geiseler, Croton. Monogr.: 44. [Mar.] 1807. *Croton lanatus* Loureiro, Fl. Cochinch. ed. 1, 2: 581. 1790, nomen illeg., non Lamarck, Encycl. 2: 211. 1788. *Croton lasianthus* Persoon, Syn. Pl. 2: 586. [Sep.] 1807, redundant name. *Croton erioanthemus* Smith, in Rees, Cycl. 10: Croton no. 21. 1808, redundant name. *Triplandra lanata* (Loureiro) Rafinesque, Sylva Tellur.: 63. 1838. TYPE: Vietnam. "In sylvis montanis Cochinchinae," s.d. (fl, fr), *J. Loureiro s.n.* (holotype, BM).

Croton limitincola Croizat, J. Arnold Arbor. 23: 45. 1942. Syn. nov. TYPE: Vietnam. Taai Wong Mo Shan, Sep. 1939 (fl, fr), *W. T. Tsang 29584* (holotype, A).

Geiseler's name is the earliest of three names replacing the illegitimate name of Loureiro. *Croton laniflorus* was misspelled as "*laxiflorus*" by the Index Kewensis, a mistake not picked up by Govaerts et al. (2000); neither works indicate that it was a replacement for Loureiro's name. *Croton lasianthus* was published a few months later than *C. laniflorus*, but has been the accepted name in the literature, following the authority of Müller (1866) and Merrill (1935).

Because the identity and many important characters of *C. laniflorus* have never been clarified (even Merrill, 1935, was in doubt), it is useful to contribute a short description of the type:

Woody plant. Indumentum consisting of stellate hairs with a brown center and pale-hyaline radii (appearing as brownish dots), flat, with ca. 15 radii. Stipules linear-elliptic, ca. 6 mm long. Leaves alternate, only immature ones on the type sheet; petioles with few hairs; immature blades membranous, elliptic, ca. 8 × 3.5 cm, index ca. 2.3, base obtuse, margin shallowly serrate, apex acute to subacuminate, glabrous above, beneath with scattered but distinct hairs; basal glands abaxial-lateral on the junction of petiole and midrib, stipitate and quite distinct, marginal glands not seen; side veins distinct on both surfaces, in 10–11 pairs, not triplinerved, arching in quite distinct loops (brochidodromous). Inflorescences only seen in fragments. Pistillate flowers: pedicel 4 mm long, with few hairs

only; sepals 4–5 × 1.5–2.5 mm, much longer than the ovary, nearly glabrous; petals not seen; ovary ca. 2 mm long, distinctly brown hispid-pubescent with long porrect radii; stylar column short (ca. 0.5 mm) but present, stigmas ca. 3 mm long, bifid on the apical ca. 2 mm, slightly flat and broadened. Fruits only seen in fragments; schizocarp 9 mm long, distinctly pubescent, smooth. Seeds not seen.

Although the holotype of *C. laniflorus* is a somewhat fragmentary collection, sufficient diagnostic characters are present. The type of *C. limitincola* is identical in all important characters studied here, and differs in more distinctly pubescent pistillate flowers and in much larger leaves up to 22 × 9 cm, but the leaves are mature and the smallest leaf on the holotype is nearly identical in size with the type of *C. laniflorus*.

Croton vietnamensis Radcliffe-Smith & Govaerts (the name replacing the illegitimate *Croton longipes* Gagnepain non M. E. Jones), described from Nhatrang, Vietnam, is probably also synonymous, although this needs further study.

Croton lissophyllus Radcliffe-Smith & Govaerts, Kew Bull. 52: 187. 1997 (nomen) ex Esser, sp. nov. *Croton laevifolius* auct. non Blume, in Hooker f., Fl. Brit. India 5: 391. 1887. *Croton khasianus* Hooker f., Fl. Brit. India 5: 392. 1887, nomen inval. *Croton hookeri* Croizat, J. Arnold Arbor. 21: 498. 1940, nomen inval. et illeg., non *Croton hookeri* André, Ill. Hort. 19: 56. 1872. TYPE: India. Meghalaya: Khasi Mountains, 2000–4000 ft. (fl, fr), *J. D. Hooker & T. Thomson s.n., s.d. ("Croton 17")* (holotype, GH).

Species *Crotonis* ad *C. laevifolium* accedit sed pilis stellatis, foliis serratis glabris vel parce pubescentibus, glandulis basilaminaribus stipitatis, fructibus bilocularibus distinguenda est.

Chakrabarty and Balakrishnan ("1992," published in 1997) contributed an excellent description and illustration of this species (as "*C. hookeri*"), and they seem to be completely correct in their circumscription. The bilocular ovaries and fruits seem indeed to separate the species from several similar Asian Crotons. The record for Thailand by Airy Shaw (1972) could not be confirmed.

This species has a remarkable nomenclatural history. Hooker (1887) had proposed the name *C. khasianus* only provisionally, allowing for the possibility that the plants he had described under *C. laevifolius* Blume on the previous page of his work turned out to be different from Blume's species. This did not constitute a valid publication (ICBN Art. 34.1; Greuter et al., 2000). Croizat (1940) was aware of that; he accepted the species and replaced the name with *C. hookeri*. He did not realize that he had created a later homonym of *C. hookeri* André. Radcliffe-Smith and Govaerts (1997) therefore replaced the name *C. hookeri* Croizat with *C. lissophyllus*. Their literature reference for *C. hookeri* André was unfortunately erroneous here and in Govaerts et al. (2000: 404), who also attributed the name to Veitch. Croizat's name, however, was not only illegitimate but also invalid, because he did not contribute a Latin description or diagnosis, and did not refer to a previously published Latin diagnosis, which is mandatory after 1 January 1935 (ICBN Art. 36.1), for which reason *C. lissophyllus* also remained invalid.

Govaerts et al. (2000) cited a synonym under *C. lissophyllus*, *C. cnidopyllus* Radcliffe-Smith & Govaerts, the name replacing the illegitimate *C. urticifolius* Y. T. Chang & Q. H. Chen non Lamarck. It was described from China (Guizhou). Although I was unable to examine original material of that species, it is improbable that it is conspecific with *C. lissophyllus*. The latter seems to be a local endemic, and its leaves are not triplinerved. *Croton cnidophyllus* might be closely related to (or even be synonymous with) *C. lachnocarpus*.

The type specimens of *C. lissophyllus* were distributed under the name of *Croton laevifolius*.

Paratypes. BANGLADESH. Silhet, Pandowah Hill, May 1822 (fem. fl), *N. Wallich 7719* (CAL not seen, K, K-WALL). INDIA. **Meghalaya:** Khasi Mountains, 13 June 1850 (fl), *J. D. Hooker & Thomson s.n.* (A, K); 20 June 1850 (fl), *J. D. Hooker & T. Thomson s.n.* (K); s.d., *J. D. Hooker & T. Thomson s.n.* ("Croton 17") (A, G-DC, NY, TCD, U); s.d. (male fl), *W. Griffith 4784* (GH, K).

Croton mekongensis Gagnepain, Bull. Soc. Bot. France 68: 558. 1921 [1922]. TYPE: Cambodia. Campong-luang, leg. 1866–1868 (fl, fr), *C. Thorel s.n.* (lectotype, designated here, P; isolectotype, P).

The Thorel collection from Campong-luang is the only one among the four syntype collections (two made by Harmand and Thorel each) with fruits. Among the two sheets at P, the one with attached drawings is chosen here.

Croton poilanei Gagnepain, Bull. Soc. Bot. France 68: 559. 1921 [1922]. TYPE: Vietnam. Baria: Nui-dinh, 25 Oct. 1919 (fl), *E. Poilane (leg. A. J. B. Chevalier) 636* (lectotype, designated here, P; isolectotypes, A, K).

Several excellent syntypes with duplicates are

available, all with analytical drawings by Delpy and used by Gagnepain attached to the Paris sheet. The chosen lectotype had already been separated in a type folder in Paris, and it is the only one among the syntypes with a label by Poilane, to whom the species was dedicated.

Croton thorelii Gagnepain, Bull. Soc. Bot. France 68: 560. 1921 [1922]. TYPE: Vietnam. "Ad montem Dinh prope Baria," Apr. 1867 (fl, imm. fr), *L. Pierre 6226* (lectotype, designated here, P; isolectotypes, BM, GH, NY).

Croton thorelii was based on nine syntype collections. All of them belong to this species and not to the similar *C. decalvatus* Esser, with which *C. thorelii* was formerly confused by some authors, such as Airy Shaw (1972) (Esser & Chayamarit, 2001). Among the syntypes in P with drawings attached, the one with the largest number of duplicates is selected here.

Gagnepain (1925: 264, fig. 28.8–10) stressed the diagnostic importance of pubescent stamens. Stamens pubescent to a various and often variable degree were found in several Asian species of *Croton*, and do not appear to be significant. The quadrifid stigmas however, also discussed by Gagnepain, seem to be diagnostic for *C. thorelii*.

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